

Gas Analyses.—Perhaps the most valuable property possessed by the gaseous fuels is that of diffusion, which admits of their combustion being effected under very close control and with only a small excess of air over that theoretically required. To enable the user to take full advantage of this, he must know the exact composition of the gas mixture in order that the quantity of air admitted to the furnace may be adjusted to what is necessary for complete combustion. As the highest degree of economy in working will be reached when the whole of the carbon and hydrogen in the gases has been burned to carbon dioxide and water, and when this has been effected with a minimum surplus of oxygen, it follows that an examination of the products of combustion passing to the chimney will afford confirmation of its attainment:

1. By the absence of unburned gases such as hydrogen and carbon monoxide, and
2. By the presence of only a moderate amount of free oxygen, indicating excess air.

As the products of combustion derived from liquid and from solid fuels are in the main identical with those generated from the gaseous fuels, the same methods of analysis are applicable to the waste gases of all three.

Analysis of Flue Gases.—If the general behaviour of the fuel in use is understood, it is frequently sufficient to make a determination of the carbon dioxide and the oxygen in the flue gases and to infer from the figures their condition as regards carbon monoxide and other combustibles. Where more exact knowledge of the latter is required, reference is made to what is said below on the general methods of gas analysis. However little may be deemed necessary in the way of analysis, it is all-important to make certain that the sample worked on is representative of what is passing through the flue, and that samples are taken in sufficient number at short intervals to eliminate the variations in composition of the gases at different stages of the combustion process. In mechanically-stoked furnaces these are less extreme than with hand firing. The samples are withdrawn from the flue or

chimney through a glass or porcelain tube into a containing vessel which may be either a separate tube of glass closed by glass stopcocks or by pinch-cocks, or may form part of the apparatus used for analysis. If the flue gases are under pressure the tubes are readily filled; if not, an aspirator may be used. A rubber aspirator is sometimes supplied with the analytical apparatus. Care must be taken to sweep out air from tubes and connections by means of the flue gases before taking the sample.

Orsat Apparatus.—What is known as the Orsat apparatus in one or other of its modifications is used for the analysis. Fig. i shows that devised by Lunge. It consists of a graduated measuring tube surrounded by a water jacket and connected at the foot to a movable bottle. The upper end connects to a series of glass pipettes closed by glass stoppers. Beyond these is placed a small horizontal tube containing a thread of palladiumized asbestos capable of being warmed by a spirit lamp. This